# **TRAINING CAREGIVERS ON MILK PRODUCTS PROCESSING IMPROVES HOUSEHOLD MILK PROCESSING AND DAIRY PRODUCTS CONSUMPTION BY UNDER-FIVE CHILDREN FROM DAIRY FARMING HOUSEHOLDS IN MALAWI**

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# **Abstract-**

Seventy nine children aged 6 to 52 months from two milk bulking groups in rural Malawi participated in an 8 months long study exploring child nutrition gains from nutrition education and milk processing training.

The training contributed to increases in household milk processing, consumption of homemade dairy products and ≥250ml milk/day by under-five children. Similarly improvement in protein, zinc energy Vitamin A also improved. Overall the children were not wasted, while improvements were observed in underweight and stunting.

Nutrition education interventions and milk products processing are therefore, potential pathways for enhancing effectiveness of dairy production interventions, on nutrition.

**Key words**: Dairy farming, households, milk, processing, nutrition, education

# **BACKGROUND INTRODUCTION**

Milk consumption in Malawi is low, currently at approximately 5.11 kg/capita/year(Malawi Government,Department of Animal Health and Livestock Development2017). Among Malawi’s dairy farming households (DFHs), milk consumption was slightly higher at 52liters/individual/year (Kalumikiza, 2012)but still below the WHO recommended 200 litres milk/individual/year.

Increasing access, availability and consumption of a variety of micronutrient-rich foods has been reported to have a positive effect on micronutrient status and also contributes to improved nutrition in general (Thompson and Amoroso, 2010). However, despite dairy farming’s potential in improving under-five nutritional status, stunting severity among under-five children from DFHs in Malawi is still on a very high prevalence level basing on(WHO 2010)classification. In Ntchisi district, central Malawi, 40.5% of under-five children from DFHs were stunted and was comparable with non-dairy households (Chilima and Matiya, 2005). Among DFHs in the central region milk shed area of Malawi stunting was found higher at 45.4% (Kalumikiza, 2012).

Similarly, food processing has been pointed out as an essential tool for making nutritionally rich foods, such as fruits, vegetables and dairy farming products, available year-round(FAO 2014), hence increasing consumption. In Malawi, milk product processing is rarely done among DFHs (Kalumikiza 2012), although fermented milk products are a good alternative to fresh milk due the nutritional content that is similar to fresh milk (apart from less lactose) and better storability(Gonfa, Foster, and Holzapfel 2001);(Michaelsen *et al.* 2009). Milk and milk-based products are easily consumed and digested by small children and also involves minimal preparation which reduces the time required for preparation (Hoddinott, Headey, and Dereje 2014).

However, to achieve maximum nutritional benefits with any intervention, inclusion of a nutrition education component aimed at improving the overall diet is necessary (Haddad, 2011). As reported in the Malawi National Nutrition Policy and Strategic Plan for (2007-2011)(Malawi Government Department of Nutrition HIV and AIDS 2009), insufficient knowledge on diets was the main reason preventing households that were producing high nutritive foods such as milk, pulses, aquaculture and small livestock from maximizing the nutritional benefits of the available foods and resources in Malawi. Filling this knowledge gap through nutrition education could help to have improved diets among DFHs in Malawi. This study therefore, incorporated nutrition education and milk processing pathways within the dairy farming intervention and assessed their effect on household milk products processing, milk/ milk products consumption by under-five children as well as their nutrition status among DFHs.

# **MATERIALS AND METHOD****S**

## **Research Design**

A quasi experimental study was implemented among DFHs from two milk bulking groups (MBGs). MBGs are milk collection centres established in dairy areas in which farmers are organized as a cooperative (Chagunda *et al*. 2010). An intact MBG was assigned to a treatment condition (intervention) and non-treatment (control) from April to December 2016 after baseline data collection. The intervention consisted of nutrition education and milk product processing training done four times at the intervention group at two months intervals for three days. The control group was trained the intervention package after end-line data collection. The intervention participants were followed up fortnightly by phone call on milk products processing and a monthly template with milk products was given for the caregivers to record daily child’s milk and milk products consumption

## **Study Area**

The study was conducted in Dedza district, central Malawi at Dzaonewekha and Chitsanzo MBGs which are within the middle altitude agro-ecological zone, receiving 800 to 1500 mm of rainfall per annum (Mwale et al. 2009). These areas have minimal variations in types of crops grown and harvest patterns hence reducing variations on diet and possibly economic status, which could have an effect on nutritional status.

## **Study Participants**

A sample of 61 households were recruited using a non- probability, purposive, total population sampling method (31 from intervention and 30 from control). This sampling design was used because of the small population with the desired characteristics in the bulking groups ( Etikan, Musa and Alkasin 2015). All children aged 6 and 52 months from the 61 households were recruited making a sample of 79 for anthropometry, from which a sub sample of index children was selected totalling 61 at baseline and 58 at end-line.  The youngest child in the household for those with more than 1 was taken as an index child and they were studied on milk and milk products consumption and dietary intake.

## **Inclusion and Exclusion Criteria**

Households with a lactating cow and children aged 6 to 52 months were eligible to participate in the study. Households with seriously ill children and whose height and weight could not be taken due to some disabilities were excluded from participating in the study.

## **Nutrition Education and Milk Product Processing**

Trained nutritionist from Lilongwe University of Agriculture and Natural Resources (LUANAR) and Ministry of Health frontline workers (Health Surveillance Assistants, HSAs) operating from the study areas delivered the nutrition education sessions. Nutrition education sessions with caregivers were combined with milk products cooking sessions and demonstrations at intervention MBG. The key messages were: beneficial nutrients found in milk and milk products; health benefits of milk and milk products and prevention of nutritional disorders among children under-five years; and recommended daily intake of milk for under-five children. Standardized nutrition messages adapted from the Scaling Up Nutrition (SUN) 1000 days key messages (Government of Malawi. Sun 1000 Special Days, 2011-2016) were given to both groups as a way of retaining the study participants in the control group. These included: age appropriate complementary feeding practices in terms of frequency, amount, density, utilization and active feeding (FADUA); caring for a sick child; growth monitoring and promotion, hygiene practices when preparing, cooking, feeding and keeping the children’s’ food and case identification for malnourished children.

Adapted and modified milk products recipes were developed for cooking sessions delivered by trained nutritionists and laboratory technicians from LUANAR. Child caregivers were trained on how to prepare fermented products such as *chambiko* and yoghurt; enriched products such as carrot and orange fleshed sweet potato milk; yoghurt and milk smoothies using locally available fruits such as bananas, avocado pears, mangoes and pawpaw’s; and coagulated milk products such as *paneer.* Caregivers in the intervention MBG were advised to give a child minimum of 250ml of milk a day plus a milk product made or bought in that day.

## **Ethics Approval for the Study**

The study was approved by the National Health Sciences Research Committee and the approval number is NHSRC # 16/3/1561. A letter of support was also sought from the District Agricultural Development Officer for Dedza district. A consent form was read out to participants and a signed / finger-printed consent was also sought from the child’s caregiver before conducting the interviews and taking anthropometric measurememnts.

## **Data Collection**

Baseline data was collected end April to early May 2016 and end-line data was collected in December 2016. An interview was conducted with a female household member responsible for running the household or who took part in running the household. A pre-tested household questionnaire with structured and semi-structured questions was used to collect data by trained nutritionists.

Measurements were taken for children under-five yearsaccording to (Cogill 2003) at all data points to construct anthropometric indices of height-for-age, weight-for-height, and weight-for-age for determining the nutritional status of the children in terms of stunting, wasting and under-weight, respectively. Weight was measured using digital electronic SECCA scales model 881 102 1659, accurate to 100g and calibrated to correct for systematic errors. Height was taken for all children 24 months and older using a height board and incumbent length was taken for children between 6 to less than 24 months. The measurements were replicated to reduce measurement errors and were recorded to the nearest 0.1 g for weight and 0.1 cm for height. Interpretation of the Z-scores of children was based on the classification by (Gibson 2005).

A 24-hour dietary recall tool was used to collect dietary intake data for the index child. The caregiver was asked to provide the types of food the child ate the previous 24 hours from sun rise until the child slept for the night. The food preparation method and all the ingredients used before, during and after cooking the food were also recorded. Household standard spoons, cups and plates were used to guide the child caregivers to provide approximate food quantities. A modified food atlas from the United Arab Emirates plus food portions from Malawi mostly found in the study area was used to help the caregiver to select the portion sizes of food the child consumed. Dietary nutrient adequacy and inadequacy cut off values were based on the cut off points by Whitney and Rolfes, (2016).Dietary diversity scores for index children were assessed based on the seven food groups for children aged 6 to 23 months and guidelines by(WHO 2007).

## **Data Management**

Anthropometric data were entered in WHO Anthro (v 3.2.2) to calculate the Z-scores for anthropometric indices of height-for-age (HAZ), weight-for-height WHZ), and weight-for-age (WAZ) Z scores. Weights of food portions the children ate were entered into a modified Nutri- survey **™** (2007), where nutrient values for Malawian foods were added based on the Tanzanian, Mozambican Ghana, Senegal, Mali and Kenyan Food Composition Data Bases (FCDB). The nutrients values were calculated for each child. The Recommended Dietary Allowances (RDA) and Adequate Intakes (AI) and Estimated Energy Requirement (EER) were analysedbased on the cut off points by (Whitney and Rolfes, 2016).

The other data were entered in CSPro 6.2.0 US Census Bureau, and then exported to SPSS version 23.0, IMB Corp, Armonk, NY for analysis.

## **Data Analysis**

Data were analysed in SPSS to generate means, SD, medians, frequencies and p- values. Descriptive statistics were computed for demographic, milk consumption and milk product processing and consumption and dietary intake by the under-five children as well as for anthropometric characteristics and nutrition status of under-five children. Chi square tests were done for proportions and t-test for means. *P*-value ˂ 0.05 was considered significant.

# **RESULTS**

## **Socio-Demographic Characteristics of Participants and study children**

Proportionately, 25% of the households with dairy cows had under-five children (n=61). It is this percentage that formed the sample for the current study. Households were mostly male headed (88.5% and 90%), with a mean household size of 6 and 7 at baseline and end-line respectively (Table 1). Overall 50% of the dairy farmers had been in the dairy farming for more than 5 years. Some households had been in dairy farming way before the MBGs were established (maximum 28 years). Households owned about 3 cows on average, of which 2.3 ±0.6 were lactating and 1.5 ±0.7were on dry.

Most households were living as extended families, thus, the children included biological children 44.3% and grandchildren 55.7% of the household head at baseline (Table 1). The 79 children that participated at baseline in this **s**tudywere on average 30 months old and 51.9% of these were male at base-line (Table 1).

## **Milk and Milk Products Processing and Consumption at Baseline and End-Line: Intervention Vs Control**

Households kept 1 to 2 litres of milk for home use and the quantity did not significantly differ between MBGs before and after the intervention (Table 3), and the other milk was sold through the milk bulking group.Children mostly consumed milk as a drink as opposed to other forms of food such as porridge and tea. Following the intervention, there was a 44.2% increase in the proportion of caregivers that reported giving their children milk as a drink. However, consumption of milk as a drink by children from the control MBG reduced by 30% at end-line.

Following the intervention, household milk product processing significantly increased by 93.5% at end-line at intervention group and was significantly higher than the control MBG (Table 3). At the end-line study, over 80% of the caregivers from the intervention MBG reported that they had made milk and fruit smoothies at least four times a week unlike at the control group where only 20% caregivers reported processing milk products at household level.

The increase in household milk and milk product processing was accompanied by an increase in consumption of home-made milk products such as smoothies, *paneer* and carrot milk by under-five children from intervention MBG (Table 3). The between groups differences at end-line were statistically significant on all home made products (Table 3). There was also a change on the source of milk products caregivers fed their children within the intervention MBG from buying at the baseline study to own production at end-line (Table 3). Buying from milk bulking groups remained the dominant source of yoghurt for children in the control MBG. The differences at end-line for home production and buying from milk bulking groups were very significant between MBGs (p˂0.001). However, as indicated in Table 4, the 24 hour dietary recall data indicated that only 10.3% of the children had consumed milk products the previous day at intervention group and none consumed at control as was the case at baseline for both groups.

In addition, according to the caregiver’s reports, at the end of the study, more (89.6%) children from the intervention MBG reported consuming the recommended ≥250ml of milk per day as compared to 60.8% at control MBG (Table 3). The caregivers’ reports were further collaborated by the results of the 24 hour dietary recall, which showed that the consumption of ≥250ml of milk per day among children from intervention MBG significantly rose by 45% (Table 4).

## **Nutrient Adequacy and Minimum Dietary Diversity among Under-Five Children Using 24 Hour Dietary Recall at Baseline and End-line**

Percentage of children meeting dietary nutrient adequacy increased for the selected nutrients indicated in (Table 5) except for potassium. Children meeting protein adequacy increased by 23.3% at end-line from 73.3% at the intervention, and by 6.4% at control even though they were slightly higher at 86.7% at baseline. Similarly, for zinc and phosphorus the increase was proportionally more (52.8% and 46.7%) for intervention than 09% and 29.2% respectively for children at control at end-line. However, the differences between groups on nutrient adequacy were not significant (Table 5) for almost all nutrients except vitamin A at baseline and end-line and for zinc at baseline. Overall, proportion of children meeting RDAs were still very low for energy, potassium and calcium at end-line.

Overall, the number of children who met the minimum dietary diversity increased by 10.6% at end-line from 80% at baseline (Table 6). There was an increase in the consumption of almost all food groups at end-line although the increase was less on flesh foods (Table 6). There was a drop by 8.6% in the number of children that consumed flesh foods at end-line from the control group but increased by 8.7% at the intervention.

## **Nutritional Status of Under-Five Children**

Non-significant differences in height existed at baseline, and children from the intervention MBG gained more height than those in the control group. The study found that children from intervention group gained 6 cm and 1.3kg at end-line while the children from the control MBG gained 5.1cm and 1.1kgs. The mean height difference increased from 0.6cm at baseline to 1.5cm at end-line in favour of the intervention group. These differences however were not significant between the groups at both data points.

As indicated in Table 7, stunting dropped by 13.5% form 34.14% in the intervention group and increased by 3.5% from 31.5% in the control group at end-line but differences were not significant. No child was wasted, while under-weight status reduced at intervention from 9.5% at baseline to 5.2% at end-line and increased at control from 7.9% at baseline to 10.8% at end-line. . Analysis of stunting among children less than two years also revealed no significant differences at both baseline and end-line between MBGs (Table 8).At baseline, 10% and 37.5% were stunted and at end-line, 12.5% and 50% were stunted for intervention and control respectively. However, the smaller sample sizes should not be ignored.

## **Predictors of Stunting Status of Under-Five Children in DFHs in Dedza District**

Results from the logistic regression indicate that relationship to the household head, particularly being a grand-parent, was a predictor of stunting (Table 9). Children whose grandparents were household heads were 30% more likely to be stunted than those who were biological. Chi square tests revealed that being a grand-child to the household head had a significant effect on stunting in the control group (p ˂0.025) but not intervention group (p ˃0.05) at end-line. Under-five children with untrained caregivers were 18% more likely to be stunted than those with training. The proportion of caregivers indicated to be trained on quantity of milk to be fed to children increased drastically at the intervention group at end-line and the differences were significant (p.˂ 0.001) with the control. Children whose caregivers did not process milk products at household level were 5% more likely to be stunted. The number of lactating cows in the household, quantity of milk produced per day, duration of dairy farming were not predictors of stunting.

# **DISCUSSION**

The study had two components, infant and young child feeding practices, which was administered to all the two MBGs. The second component was milk and milk products processing which was administered to the intervention MBG. The milk product processing trainings at the intervention group significantly resulted into increased household milk product processing, which subsequently influenced consumption of the milk products by the under-five children in those households. Similarly, the intervention significantly resulted into an increase in children that consumed ≥250ml of milk per day based on a 24 hour dietary recall. The nutrition education on infant and young child feeding practices which was administered to bothMBGs contributed to increased proportion of children meeting minimum dietary diversity and also on dietary nutrient adequacy for carbohydrates, vitamin A, calcium, phosphorus and zinc. The intervention however, did not have significant effects on nutritional status indices between under-five children from the intervention and control group despite proportional differences being in favour of intervention children. The comparison of children within dairy farming, could explain the lack of significant differences on nutritional status coupled with the study duration especially for stunting.

The results of this study on household milk product processing and consumption demonstrate that household milk product processing combined with nutrition education aimed at providing knowledge on importance of milk, increases milk product consumption by under-five children among dairy households. The big difference between baseline and end-line values within the intervention group in household milk products processing, provides strong evidence on the positive effect of milk product processing training as an intervention. Instilling milk product processing skills among DFHs could be one way of ensuring sustainability of household milk product processing and consumption as caregivers would pass the skills to their children. This could help to improve the milk consumption among DFHs through product diversification. Similarly, studies conducted among DFHs that processed milk products in Kenya (Nicholson, Thornton, and Muinga 2004) and in Ethiopia(Beriso 2015)(Lenjiso, Smits, and Ruben 2016) reported consumption of home-made milk products such a butter, cheese and fermented milk products by children as well as adults. Therefore, product availability at household level has significant effect on the likelihood of it being consumed. Nutrition interventions that aim at increasing awareness of the nutritive value of milk and importance of feeding adequate amounts of milk to under-five children provided concurrently with household milk products processing are therefore, some of the strategies to increase milk consumption among DFHs. Quick, easy to make products requiring local accessible ingredients such as milk and fruit smoothies would increase milk consumption that is also rich in nutrients from fruits. Adequate milk consumption is the direct pathway for dairy farming in mitigating under-five malnutrition.

On the other hand, initiating milk value addition at MBGs where milk products are processed could be one way of improving children’s nutritional status directly and indirectly for DFHs and the surrounding community through increased milk consumption. The control MBG processed flavoured yoghurt packed in 100ml sachets sold at MKW100[[1]](#footnote-2) since April 2016. The development influenced dairy farmers to purchase the product on credit to be deducted from the monthly milk sales. The proximity of yoghurt at the MBG at a reasonable price influenced dairy farmers to buy yoghurt sometimes since milk was delivered to the MBG on a daily basis. The sale of yoghurt at the MBG would also increase profits for the members, resulting into improved livelihoods of the dairy-farming households through increased milk revenue. It is expected that improved household income would in turn contribute to nutritious diet with proper adequate nutrition knowledge, plus household food security and access to good medical care if a child gets sick.

Similarly, educating caregivers on the recommended daily intake of milk for children positively resulted into increased the quantity of milk consumed by children. Significantly more children at intervention MBG consumed ≥250ml of milk at end-line than children in the control MBG. Giving a child milk as a drink seemed to be easier, quicker and not time consuming as any older household member could give the child the milk as compared to cooking porridge or making some products which could take more time and required skills. However, the amount of milk reserved by the farmers still ranged from 0.5 to 2.5 litres.

The nutrition education provided to caregivers at both MBGs on age appropriate complementary feeding practices contributed to improved nutrient adequacy for the children at the end of the study. The study’s end-line results reflect the evidence available on the effect of nutrition education on improved dietary intake. Inaddition to milk consumption, the households also had increased consumption of animal source foods (although at the intervention group) such as eggs, meat and fish mostly the small fishes such as *bonya and usipa (Engraulicypris sardella)*. It is most likely that through the nutrition education households allocated more money for nutritious foods. Similarly,(Muehlhoff, Bennett and McMahon 2013) concluded that consumption of cow milk could make a significant contribution to meeting the required nutrient intakes since it is energy-dense and provides high quality proteins.

The results of this study on minimum dietary diversity was higher than the national 27% and 21.2% for Dedza district among children 6 to 23 months(NSO 2015). However, it should be noted that our results combined all the under-five children (6 to 59 months), hence the increased percent. The greater proportion of the children above two years in this study at both baseline and end-line could have contributed as they eat more foods than those less than 2 years.At baseline 25 out of 61 children were below two years and proportion reduced at end-line. Similarly, (NSO 2015) report also found that slightly higher proportion of older (18-23 month old) children (34 percent) were achieving the minimum dietary diversity. It should also be noted that the flesh foods that children ate were mostly small fish such as *matemba (Barbus paludinosus*) and *bonya.* At end-line it was mango fruits season as such this contributed to the increase in vitamin A rich fruits and vegetables consumption.

The results on linear growth are in line with the evidence generated by other studies on the effect of milk and milk products consumption on linear growth among children. Quasi-experimental studies that gave milk and milk product supplements found a positive association with linear growth. A study in Kenya found that children who received milk supplementation daily for 23 months over a two-and-a-half-year period had a 1.3 cm greater increase in height (15%) than the control group among children stunted at baseline (Grillenberger et al. 2003). The results of this study found a mean height difference of 0.8 cm for just a period of eight months (April 2016 to December 2016). Another study that provided milk to 7-8 year olds school children also found that milk increased height by 0.4cm, and weight by 0.5kg for a period of six months (Lien do et al. 2009). However, these comparisons are made acknowledging that the current study did not directly provide the milk and milk products supplements, but rather provided strategies to increase consumption at household level. Our study design therefore, could be more cost effective strategy and sustainable because it involved caregivers implementing at household level using their resources.

The results for the intervention group suggest the possibility of a positive contribution to improved stunting status with increased duration of the intervention. At end-line, children from the intervention group were in a medium prevalence while the control fell into high prevalence on stunting based on cut-off values for public health significance (WHO 2010). Evidence supports that stunting is easier to be reversed with early treatment, and the first 2 years especially seem to be a “window of opportunity.” (Michaelsen et al. 2009). . Similarly, a previous study found that children that were stunted benefited more from milk supplement and gained more height than control(Grillenberger et al. 2003). The improved number of children from moderately to non-stunted in this study at the intervention group could be due to the intervention’s effect. A meta-analysis of interventions that provided dairy products on physical stature found that nutritionally deprived children (shorter height-for-age) benefited more from supplementation of 245 ml of milk addition to children’s diet for a12 months averaged intervention (Muehlhoff,.; Bennett,and McMahon 2013).

Overall, children from this study had better stunting, wasting and under-weight status irrespective of group when compared to the national statistics where stunting is at 37% (39% for rural children), wasting at 3.3% and 12% for underweight (NSO,2016). The difference provides an indication of the relative positive impact of dairy farming on nutritional status of children.

Underweight despite being a measure of chronic under nutrition, it also reflects recent nutritional inadequacy in children affected by disease and poor food intake. However, children from intervention group maintained a lower prevalence under-weight status which could also be due to the intervention’s effect. At the control MBG, under-weight status increased to medium prevalence at end-line.

Caregivers’ knowledge on appropriate feeding practices of milk had major impact on a child’s nutritional status irrespective of the household head or owner of the cow. At intervention group, being a grandchild was not associated with the odds of the child being stunted than control at end-line. However, this study did not focus on reasons why grand children were prone to stunting.Our results also reflects what other studies reported that community education provided to mothers and caregivers in their homes or communities effectively generated improvements in nutritional status of under-five children even among illiterate populations (Bhandari et al. 2004)(Majamanda et al. 2014).

**Conclusion**

Nutrition education interventions and milk products processing are therefore, potential pathways for enhancing effectiveness of dairy production interventions, on nutrition.Nutrition education that aim at increasing awareness of the nutritive value of milk and importance of feeding adequate amounts of milk to under-five children should be provided concurrently with household milk products processing to child caregivers. These are therefore, some of the strategies to increase milk consumption among DFHs. Consumption of quick, easy to make products requiring locally accessible ingredients such as milk smoothies could increase milk consumption.

Differences were significant on household milk products processing, consumption of homemade milk products and ≥250ml of milk per day between intervention and control group but not on nutrient adequacy. As such, children from the intervention group grew proportionately taller, were less stunted, and weighed heavier than the control group. However, differences were not significant for weight, height, wasting, underweight and stunting.

**Implication for Research and Practice**

Nutrition interventions that aim at increasing awareness of the nutritive value of milk and importance of feeding adequate amounts of milk to under-five children provided concurrently with household milk products processing are therefore some of the strategies to achieve maximum nutritional benefits in dairy interventions.

Participatory approaches should be used in milk product processing trainings using local or modern technologies that have been adapted to suit the target group’s environment in terms of foods available and materials commonly used should be used as a way of increasing milk consumption through product diversification. This could create a platform for knowledge and skills sharing as caregivers would be passing on to their children.

**Conflict of Interest**

This research was made possible by financial support from Feed the Future; United States Agency for International Development (USAID) and Africa Research In Sustainable Intensification for the Next Generation (Africa RISING). Contents of this document are sore responsibility of the researchers and do not reflect views of funding agencies. The authors declare that they have no conflicts of interests.

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1. Exchange rate of 1 USD =MKW 720.00 [↑](#footnote-ref-2)